

Two new species of *Lepidosperma* (Cyperaceae) occurring in the Perth area of Western Australia

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Abstract

Barrett, R.L. & Wilson, K.L. Two new species of *Lepidosperma* (Cyperaceae) occurring in the Perth area of Western Australia. *Nuytsia* 23: 173–187 (2013). *Lepidosperma apricola* R.L.Barrett is a new species from the Darling Range in Western Australia. An isolated population also occurs in Kings Park, in the heart of Perth. This species has been confused with *L. leptostachyum* Nees. in the past. *Lepidosperma calcicola* R.L.Barrett & K.L.Wilson is a new species from coastal dune systems on the west coast of Western Australia, which has been previously confused with a number of other taxa. It has been listed on *FloraBase* as *Lepidosperma* sp. Coastal Dunes (R.J. Cranfield 9963). Both are common species occurring in the Perth region of Western Australia (and more broadly in the South West Botanical Province) that have been unnamed up until now.

Introduction

This paper is part of the on-going revision of *Lepidosperma* Labill., where Barrett and Wilson (2012) have now resolved the application of all 73 published names, paving the way for the description of currently unnamed and new taxa. A revised edition of the book *Perth plants* (Barrett & Pin Tay 2005) is in preparation and taxonomic resolution of these and a number of unnamed taxa in other groups is considered desirable prior to its publication (see also Barrett 2012c). Provision of a key to species must await the description of the majority of new species. Numerous illustrations are provided as an aid to accurate identification of the species named here.

One taxon that is common on the Darling Range near Perth is named here as *L. apricola* R.L.Barrett. This taxon has usually been included under *L. leptostachyum* Nees (Wheeler & Graham 2002 in part; Barrett & Pin Tay 2005). This species was included in the *Flora of the Perth region* as *L. sp. F* (Rye 1987). Markey (1997) also recognised this taxon as being distinct (as *Lepidosperma* Type C). This species has informally been known as *L. sp. 'leptostachyum Compact Inflorescence'* (Barrett 2006) or

L. sp. ‘Darling Range Heath’ (Barrett 2012b). Phylogenetic studies using molecular characters have confirmed that the taxon described here is distinct from *L. leptostachyum*, actually being more closely related to the morphologically dissimilar *L. effusum* Benth. (Barrett 2012b).

One coastal taxon that has been the subject of much confusion in the past is named here as *L. calcicola* R.L.Barrett & K.L.Wilson. Currently listed on *FloraBase* as *Lepidosperma* sp. Coastal Dunes (R.J. Cranfield 9963) (Western Australian Herbarium 1998–), this taxon has variously been included under *L. angustatum* R.Br. (Barrett & Pin Tay 2005), *L. costale* Nees (Barrett & Pin Tay 2005), *L. pubisquamatum* Steud. (Wheeler & Graham 2002 in part; Barrett & Pin Tay 2005), *L. squamatum* Labill. (Scott & Negus 2002), or *L. sp.* Coastal Dunes (Dixon 2011). This species was included in the *Flora of the Perth region* and the two forms included here were recognised separately as *L. sp.* B and *L. sp.* D (Rye 1987). The name *L. sp.* F1 Coastal Dunes was applied by K LW during preliminary sorting of specimens at PERTH and NSW. Application of the name *L. squamatum*, also much confused in the past, has now been resolved and is applicable to a taxon from the southern coast of Western Australia (Barrett 2012a). Molecular phylogenetic studies have confirmed that the taxon described here is distinct from each of these taxa, actually being more closely related to the morphologically dissimilar *L. scabrum* Nees (Barrett 2012b).

Methods

The description is based on herbarium specimens only. Specimens were examined using light microscopy, and measurements of specimens followed the methods described in Barrett (2007). Leaf, culm, nut and spikelet characters were also imaged using a Jeol JCM 5000 NeoScope bench-top scanning electron microscope (SEM) at Kings Park and Botanic Garden. The senior author has also made extensive field observations of these species that have been incorporated in this manuscript.

One unusual term is used here: the ‘angle of fan (ramet) spread’. The angle of the spread of the outermost leaves of an individual ramet (a single unit in a clonal plant) or fan of growth is given as it indicates the growth habit of the plant. This can be quite useful to distinguish some taxa with distichous leaves.

The term ‘vertical rhizomes’ describe a particular mode of ramet growth in which new ramets (plantlets) are produced almost vertically above the preceding ramet, often well above the current ground level, though produced from the rhizome, not the leaves. This is a strategy adopted by a number of coastal taxa growing in areas prone to sand movement to ensure they do not get buried. Most species in the genus produce new ramets beside the existing ramet at about the same height, just below ground level. Species with vertical rhizomes can also produce new ramets at the same height by means of stoloniferous lateral rhizomes, but these are then separated from the parent ramet by this means.

Measurements of the width (diameter) of the rhizome scales, spikelets and individual bracts have been made as they are, i.e. they are not flattened, as they usually break in the process. The measurements made in the ‘curved’ position are considered to be the most accurate and repeatable means of measuring these characters.

Taxonomy

Lepidosperma apricola R.L.Barrett, *sp. nov.*

Type: road verge at 38 Nelson Crescent, Lesmurdie, Darling Range, east of Perth, Western Australia, 8 January 2013, R.L. Barrett RLB 7825 (*holo*: PERTH 07984588: *iso*: AD, BM, BRI, CANB, K, MEL, NE, NSW).

Lepidosperma sp. F, B.L. Rye, in N.G. Marchant, J.R. Wheeler, B.L. Rye, E.M. Bennett, N.S. Lander & T.D. Macfarlane (eds), *Flora of the Perth region* 891–892 (1987).

Clump-forming tufted perennial, with short adventitious rhizomes which are 10–50 mm long, not vertical, forming clones to about 0.4 m across. Rhizome scales dark chocolate-brown, grading to reddish brown at the surface, becoming fibrous with age, 6.5–10.5 mm long, 2.0–4.6 mm diam., closely appressed to the rhizome, usually breaking up and becoming fibrous, the apex subacute to acute. *Culms* and *leaves* distichous; leaf to culm length ratio 0.01–0.5:1; angle of fan (ramet) spread 5–10°. *Leaves* equitant, rigid, erect, blade reduced to a short bract-like point or well developed, compressed biconvex to subterete, lacking acute margins, dull green, not glaucous, blades finely ridged or striate with 32–36 stomatal columns, 20–390 mm tall, 0.7–0.9 mm wide, 0.3–0.6 mm thick; sheath reddish brown to dark brown, glabrous, the base becoming somewhat fibrous with age, without resin. *Culms* not as compressed as leaves, usually subterete to terete, finely ridged or striate with 38–58 stomatal columns, 250–950 mm tall, 1.0–2.1 mm wide, 0.8–1.9 mm thick, lacking acute margins. *Inflorescence* compact, more or less obconic in outline, 30–75 mm long, 15–50 mm wide, with numerous short branches, one lateral branch per node; basal lateral branch 11–37 mm long with 7–22 spikelets; involucre bract 15–69 mm long. *Spikelets* 4.5–7.6 mm long, the upper flower bisexual, the lower flower functionally male. *Glumes* 6–8, keeled, dark brown, grading to reddish brown towards the margins with narrow, opaque, fimbriate margins, the exposed surface around the keel evenly covered with short, appressed to ascending white or rusty hairs (glabrous below), the apex acute to apiculate; sterile glumes 4–6; fertile glumes 4.2–7.1 mm long, 1.8–2.8 mm wide. *Hypogynous scales* 6, falling with the nut, very narrowly triangular, white, 0.9–1.4 mm long; apex acute to attenuate, with scattered short hairs. *Stamens* 3; anthers 1.8–2.4 mm long, 0.6–0.7 mm wide with an apical appendage 0.7–0.9 mm long; filaments 3.3–4.0 mm long; pollen 25–30 µm across, sub-globular, with several large irregular surface pits. *Style* 3-fid, unbranched portion 3.6–4.5 mm long, branches 1.8–2.9 mm long; style base continuous with ovary, caducous; stylar cap small. *Nut* pale brown to reddish brown, smooth, with 3 distinct ribs, obovoid, terete in section, 2.6–3.1 mm long, 1.3–1.6 mm wide; epidermal cells mostly round, some shortly oblong. (Figures 1–4)

Diagnostic characters. *Lepidosperma apricola* is distinctive in having the following combination of characters: compact, many-branched inflorescences with spikelets that markedly diverge from the axis of the inflorescence branchlets; terete to subterete, finely striate culms; compressed, well-developed leaf blades with bases that break down with age, becoming fibrous.

Selected specimens examined (52 seen). WESTERN AUSTRALIA: W of Badgingarra on Jurien Bay–Eneabba road, 27 May 1971, A.M. Ashby 3770 (PERTH); Narrogin, 30 Aug. 1959, S.T. Blake 20750 (BRI, PERTH); 30 m SE of Davey Road, 1.78 km S of junction with Redmond Hay River Road, Walpole Region, 12 Mar. 1997, N. Casson & K. Kershaw W 181.6 (PERTH); road to Mount Adams, 15.3 km from Brand Highway, 28 May 1997, R. Davis 3280 (PERTH); corner Gavins Road and Capel–Donnybrook Road, close to Donnybrook, 23 Oct. 1997, R. Davis 4427 (PERTH); Mount

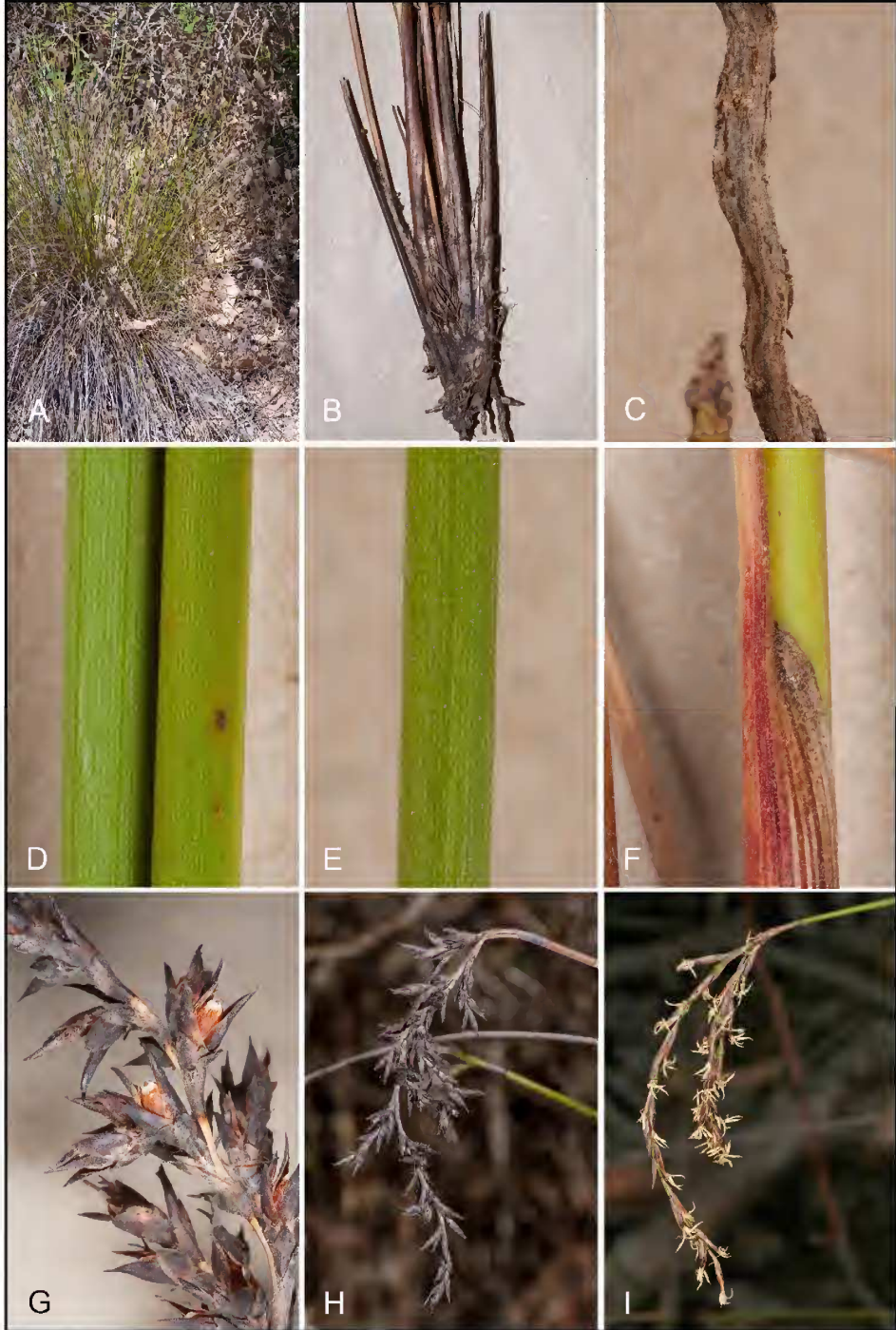


Figure 1. A–H. *Lepidosperma apricola* type location and collection. A – habit; B – fibrous base of leaf sheaths; C – rhizome; D – culm; E – leaf; F – leaf sheath apex; G – spikelets; H – fruiting inflorescence (R.L. Barrett RLB 7825, PERTH). I – Flowering inflorescence of *L. leptostachyum* near York, Western Australia (not vouchered).

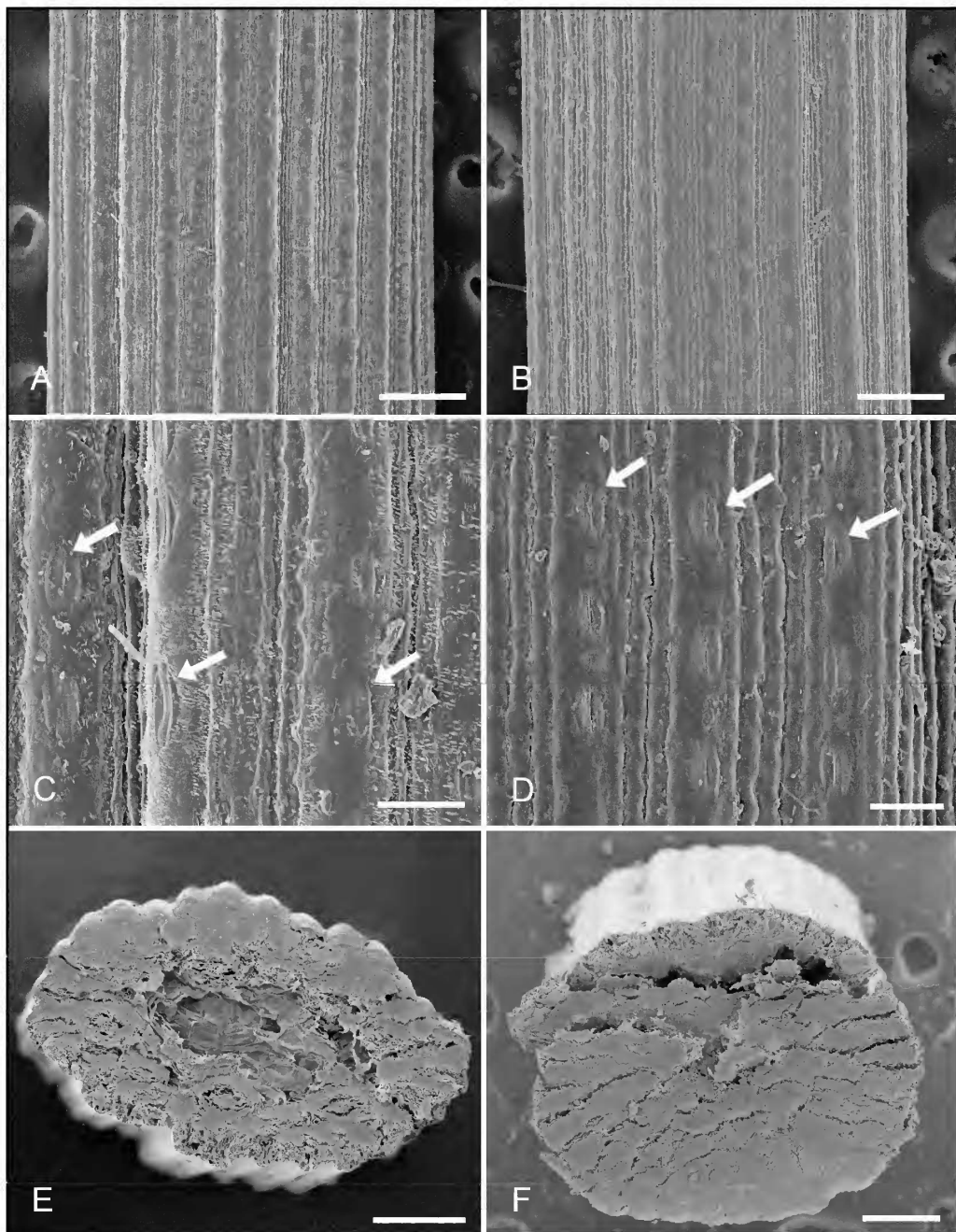


Figure 2. Leaf of *Lepidosperma apricola* (scanning electron micrographs). A – leaf surface; B – culm surface; C – stomatal columns on leaf (arrows indicate stomata); D – stomatal rows on culm (arrows indicate stomata); E – leaf cross section; F – cross section of culm (A, C, E – *G.J. Keighery & N. Gibson* 6286, PERTH; B, D, F – *R. Davis* 3280, PERTH). Scale bars. A = 200 μ m; B = 200 μ m; C = 50 μ m; D = 100 μ m; E = 200 μ m; F = 200 μ m.

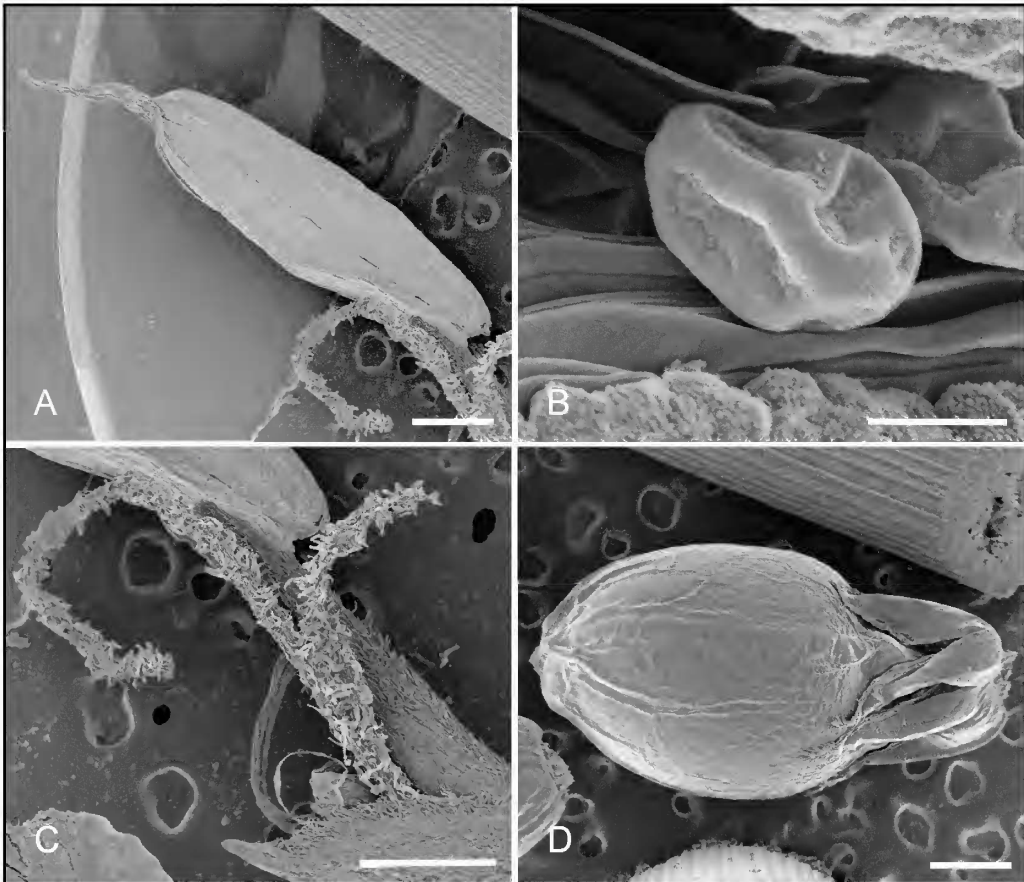


Figure 3. *Lepidosperma apricola* (scanning electron micrographs). A – anther, showing appendage at left; B – pollen (possibly partly collapsed under vacuum); C – style (only two branches visible); D – nut with attached hypogynous scales (A–C – R. Davis 3280; D – G.J. Keighery & N. Gibson 6286, PERTH). Scale bars. A = 500 μm ; B = 20 μm ; C = 500 μm ; D = 500 μm .

Lesueur, NE of Jurién, 19 July 1979, E.A. Griffin 1936 (PERTH); S side Namming Nature Reserve, c. 5 km W Brand Highway on Hunter Road, 10 Sep. 1988, B.J. Keighery s.n. (CANB, PERTH); on S side of reserve boundary track, 4.3 km E of Darkin Road, track leaves road 3.2 km S of Qualen Road. Wandoo Conservation Park, c. 35 km WSW of Beverley, [Plot - YO04], 31 Aug. 1997, G.J. Keighery & N. Gibson 6286 (PERTH); on E side of Numbat Road, 100 m S of Echidna Road, Tutanning Nature Reserve, c. 24 km E of Pingelly, [Plot - WK25], 31 Aug. 1997, G.J. Keighery & N. Gibson 6292 (PERTH); off Crystal Brook Road, Roleystone; S of track, (Plot - CSBK03), 26 Sep. 1996, A. Markey 1188 (PERTH); 13 km E of Williams, 13 Sep. 1975, K.R. Newbey 4795 (PERTH); 27 km NE of Boyup Brook, 25 Jan. 1980, K.R. Newbey 6656 (PERTH); Foxes Lair, 8 May 2005, P. Rose 420 (PERTH); transect 3, Lake Kulicup, on the south-eastern side of lake c. 300 m W along rail line formation from South Kulicup road, c. 25 km E of Boyup Brook, 24 Sept. 2001, A. Webb & B. Muir 466 (PERTH); c. 10.5 km SE of Toodyay on Clackline road, 11 Nov. 1994, K.L. Wilson 8878 & K. Frank (NSW 363989, PERTH); 15 km W of York on the Great Southern Highway to Perth, 11 Nov. 1994, K.L. Wilson 8886 & K. Frank (NSW, PERTH).

Phenology. Flowering recorded for May, coincident with the onset of winter rainfall. Fruit maturing in late spring.

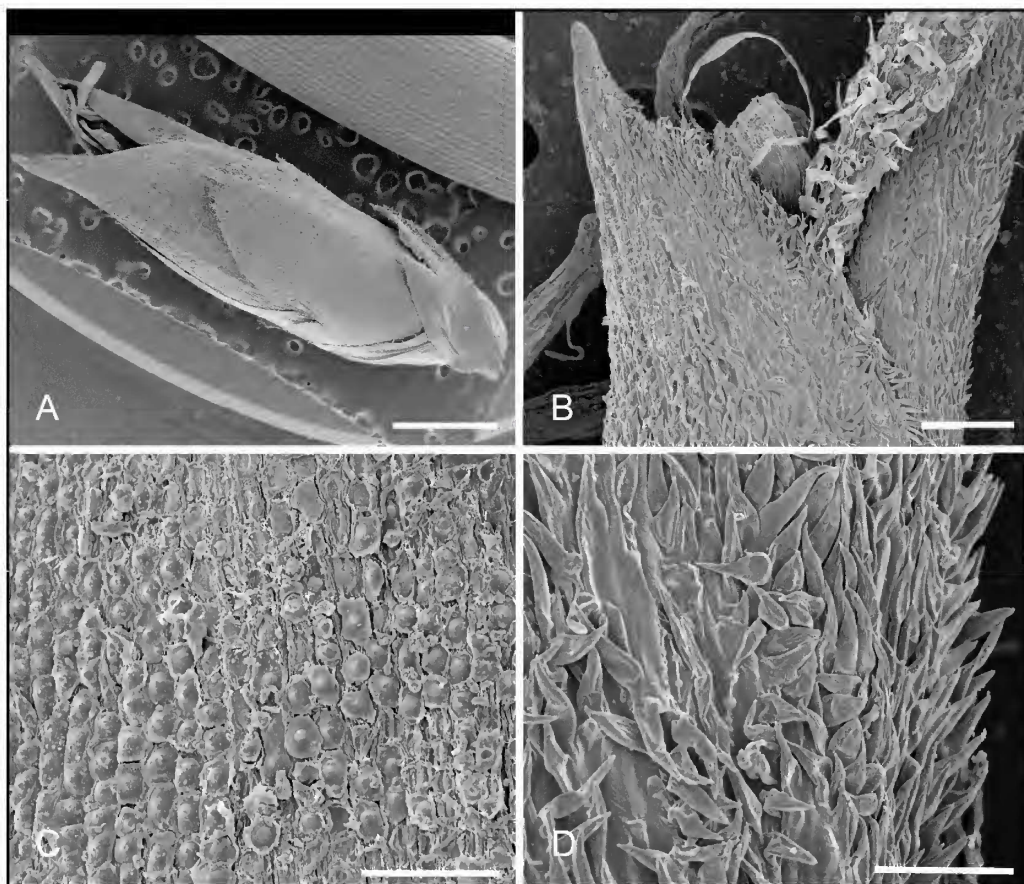


Figure 4. *Lepidosperma apricola* (scanning electron micrographs). A – spikelet; B – glume near apex of spikelet; C – older glabrescent glume surface; D – margin of fertile glume (A – G.J. Keighery & N. Gibson 6286; B–D – R. Davis RD 844, PERTH). Scale bars. A = 1 mm; B = 200 μ m; C = 100 μ m; D = 100 μ m.

Distribution and habitat. Relatively widespread in the south-west of Western Australia, from the Darling Range between Mount Lesueur and Walpole, extending inland to Beverley and Narrogin, with an isolated population in Kings Park on the Swan Coastal Plain (Figure 5). A common species in open heath communities that often occur as pockets in jarrah or wandoo forest on laterite, commonly growing in association with *Acacia lasiocarpa*, *A. pulchella*, *A. saligna*, *Allocasuarina fraseriana*, *A. humilis*, *Amphipogon turbinatus*, *Astroloma foliosum*, *Austrostipa elegantissima*, *Banksia dallanneyi* var. *dallanneyi*, *Beaufortia micrantha*, *Calothamnus quadrifidus*, *Chamaescilla corymbosa*, *Conostylis setosa*, *Corymbia calophylla*, *Daviesia striata*, *Desmocladus fasciculatus*, *Dianella revoluta*, *Eucalyptus marginata*, *E. wandoo*, *Gonocarpus pithyoides*, *Haemodorum laxum*, *Hakea erinacea*, *H. incrassata*, *H. prostrata*, *H. trifurcata*, *Hibbertia hypericoides*, *H. subvaginata*, *Hovea pungens*, *Lepidosperma asperatum*, *L. sp.* Gosnells (A. Markey 1145), *Leptospermum erubescens*, *Macrozamia riedlei*, *Marianthus bicolor*, *Melaleuca cuticularis*, *M. lateritica*, *Mesomelaena tetragona*, *Petrophile seminuda*, *Tetraria sp.* Jarrah Forest (R. Davis 7391), *Tetrariopsis octandra* and *Xanthorrhoea preissii*. Occasionally occurs on sand with *Adenanthos cygnorum*, *Banksia attenuata*, *B. menziesii*, *B. sessilis*, *Eremaea pauciflora*, *Eucalyptus patens*, *Jacksonia furcellata*, *Petrophile seminuda* and *Phlebocarya ciliata*.

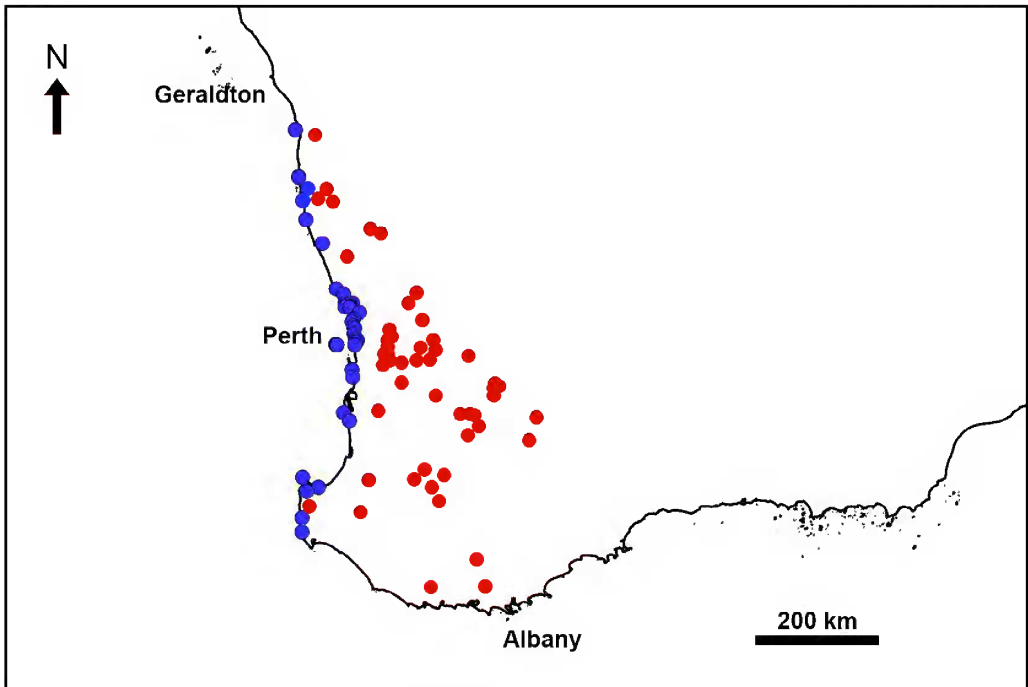


Figure 5. Distribution of *Lepidosperma apricola* (●) and *Lepidosperma calcicola* (●). Map based on data from specimens at the Western Australian Herbarium (<http://florabase.dec.wa.gov.au>) and Australia's Virtual Herbarium (<http://avh.ala.org.au/>).

Conservation status. Widespread and not threatened.

Etymology. From the Latin *apricus* (sunny) and *-cola* (dweller), in reference to the habitat of this species, which occurs in sunny places in open heath. This differentiates it from the otherwise co-occurring and morphologically similar *L. leptostachyum*, which grows in shady areas in the surrounding jarrah forest.

Notes. The overall appearance of this species is strikingly similar to *L. leptostachyum*, the habit and culms being almost identical. The inflorescence form is, however, quite distinctive and the two species are easily separated on this basis and other characters outlined below.

Superficially similar in appearance to *L. leptostachyum*, but *L. apricola* is distinctive in having compact, many-branched inflorescences. The spikelets diverge from the axis of the inflorescence branchlets (appressed in *L. leptostachyum*) giving a very different appearance to the inflorescence (Figure 1H–I). The sheathing bases of the leaves break down, becoming fibrous, and the rhizomes are not as tightly clumping as in *L. leptostachyum*. The leaves also regularly have well-developed blades, whereas they are almost always reduced to a bract-like sheath in *L. leptostachyum*. The two species are genetically dissimilar as indicated by highly divergent molecular sequence data (Barrett 2012b).

Tunnels in the culms of this species have been observed, formed by an unidentified moth larva possibly belonging to the genus *Elachista* (Kaila 2011; Barrett 2013).

Lepidosperma calcicola R.L.Barrett & K.L.Wilson, *sp. nov.*

Type: Bold Park, north of Oceanic Drive, opposite Waldron Drive, Town of Cambridge, Perth, Western Australia, 29 August 2012, R.L. Barrett RLB 7797 (*holo*: PERTH 07984553; *iso*: AD, BM, BRI, CANB, K, MEL, NE, NSW).

Lepidosperma sp. B, B.L. Rye, in N.G. Marchant, J.R. Wheeler, B.L. Rye, E.M. Bennett, N.S. Lander & T.D. Macfarlane (eds), *Flora of the Perth region* 890–891 (1987), *p.p.*, (excluding south coast specimens).

Lepidosperma sp. D, B.L. Rye, in N.G. Marchant, J.R. Wheeler, B.L. Rye, E.M. Bennett, N.S. Lander & T.D. Macfarlane (eds), *Flora of the Perth region* 891 (1987).

Lepidosperma sp. Coastal Dunes (R.J. Cranfield 9963), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au/> [accessed 14 August 2012].

Tufted perennial, with adventitious rhizomes which are 50–100 mm long, not or rarely vertical, forming clones to over 1 m across. Rhizome scales almost black at the base, grading to dark chocolate-brown, becoming fibrous with age, 14–32 mm long, 2–3.5 mm diam., closely appressed to the rhizome, usually breaking up and becoming fibrous, the apex subacute. *Culms* and *leaves* distichous; leaf to culm length ratio 0.5–1.2:1; angle of fan (ramet) spread 10–20°. *Leaves* equitant, rigid, erect, compressed biconvex, with very fine ridges on margins and 3–7 deeper ridges at regular intervals across the blade (visible on both fresh and dried material), dull green, not glaucous, with 9–21 stomatal columns per face, 100–590 mm tall, 0.9–2.0 mm wide, 0.3–0.6 mm thick; margins cream or pale straw coloured, almost smooth, not resinous, without hairs; sheath dark chocolate brown, glabrous, the base becoming somewhat fibrous with age, without resin. *Culms* as for leaves but not so compressed, with 9–23 stomatal columns per face, 150–690 mm tall, 1.4–2.8 mm wide, 0.5–1.1 mm thick; margins as for leaves. *Inflorescence* compact, obovoid to obconic in outline, 20–60 mm long, 10–35 mm wide, with few short branches, one lateral branch per node; basal lateral branch 11–32 mm long with 4–25 spikelets; involucre bract 12–51 mm long. *Spikelets* 5.3–7.6 mm long, the upper flower bisexual, the lower flower functionally male. *Glumes* 6–8, keeled, dark reddish brown with narrow, opaque, fimbriate margins, the exposed surface around the keel evenly covered with short, appressed to ascending white hairs, glabrous below and towards margins, the apex acute to apiculate; sterile glumes 4–6; fertile glumes 3.9–6.1 mm long, 1.5–2.0 mm wide. *Hypogynous scales* 6, falling with the nut, broadly triangular, white, 0.75–1.1 mm long; apex acute to attenuate, with scattered short hairs. *Stamens* 3; anthers 2.3–3.0 mm long, 0.6–0.7 mm wide with an apical appendage 0.5–0.7 mm long; filaments 3.7–4.0 mm long; pollen 20–25 µm across, ± spherical, with large irregular surface pits. *Style* 3-fid, unbranched portion 3.5–4.3 mm long, branches 1.5–3.8 mm long; style base continuous with ovary, caducous; stylar cap large. *Nut* cream (pale straw coloured) to pale brown, smooth, with 3 ribs, obovoid, terete in section, 2.3–2.5 mm long, 1.25–1.40 mm wide; epidermal cells irregular, narrowly oblong to round. (Figures 6–9)

Diagnostic characters. *Lepidosperma calcicola* is distinctive in having the following combination of characters: compact ramet bases (rarely with vertical rhizomes) with long stoloniferous rhizomes; rhizome bracts that are closely appressed, the apices becoming fibrous and breaking up with age; biconvex culms that are very finely grooved and the margins are smooth; inflorescence compact, lateral branches short; spikelets 5.3–7.6 mm long, glumes dark reddish brown with narrow, opaque, fimbriate margins, the exposed surface around the keel evenly covered with short, appressed to ascending white hairs, glabrous below and towards margins, the apex acute to apiculate.

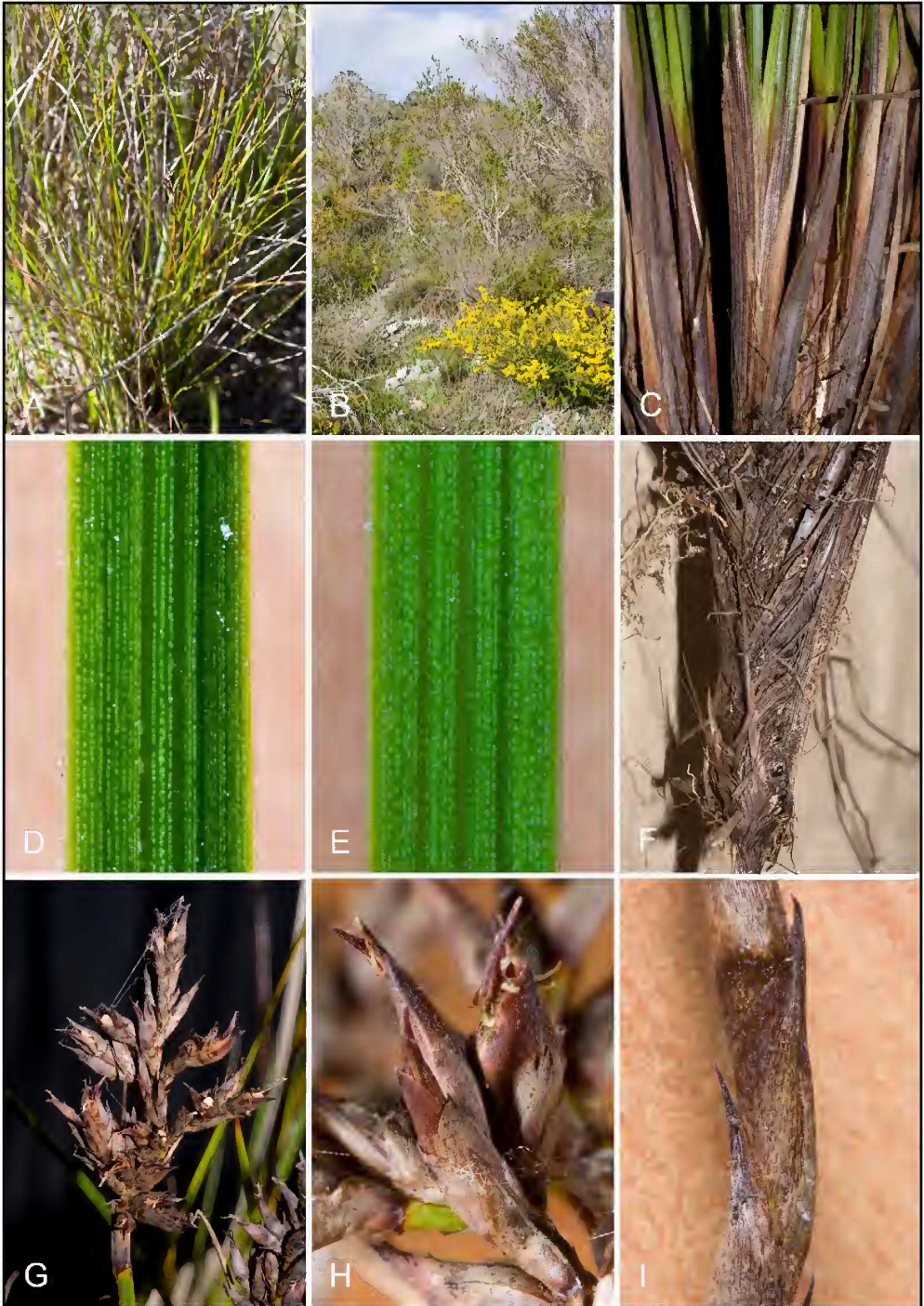


Figure 6. Type location and collection of *Lepidosperma calcicola*. A – habit; B – habitat; C – culms and leaf sheaths; D – culm; E – leaf; F – fibrous bases of leaf sheaths; G – inflorescence; H – spikelets; I – rhizome scale-bracts (R.L. Barrett RLB 7797, PERTH).

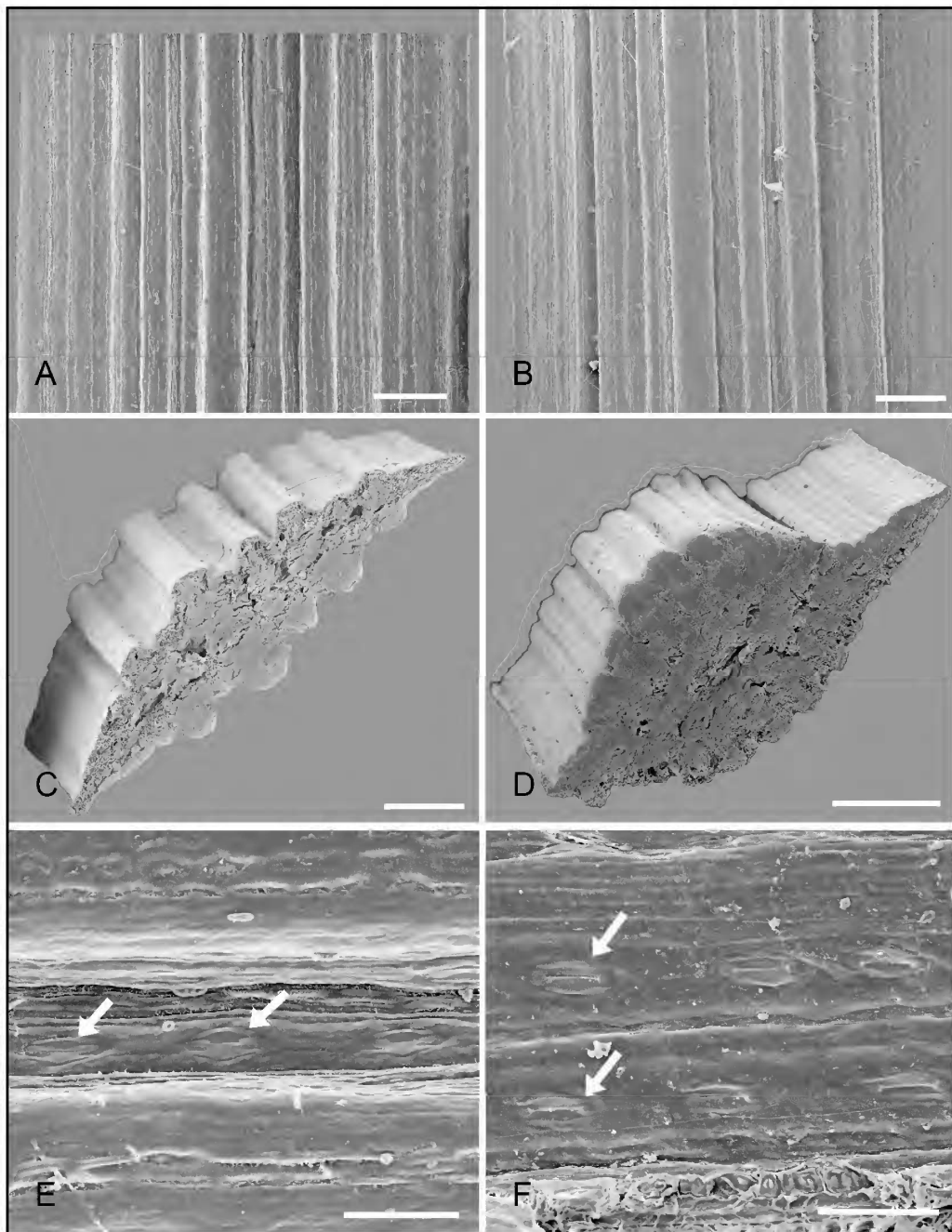


Figure 7. *Lepidosperma calcicola* (scanning electron micrographs). A – leaf surface; B – culm surface; C – leaf section; D – culm section; E – stomata in bottom of culm groove (arrows indicate stomata); F – stomatal columns (arrows indicate stomata) (R.L. Barrett RLB 2660, PERTH). Scale bars. A = 200 μ m; B = 200 μ m; C = 200 μ m; D = 500 μ m; E = 50 μ m; F = 50 μ m.

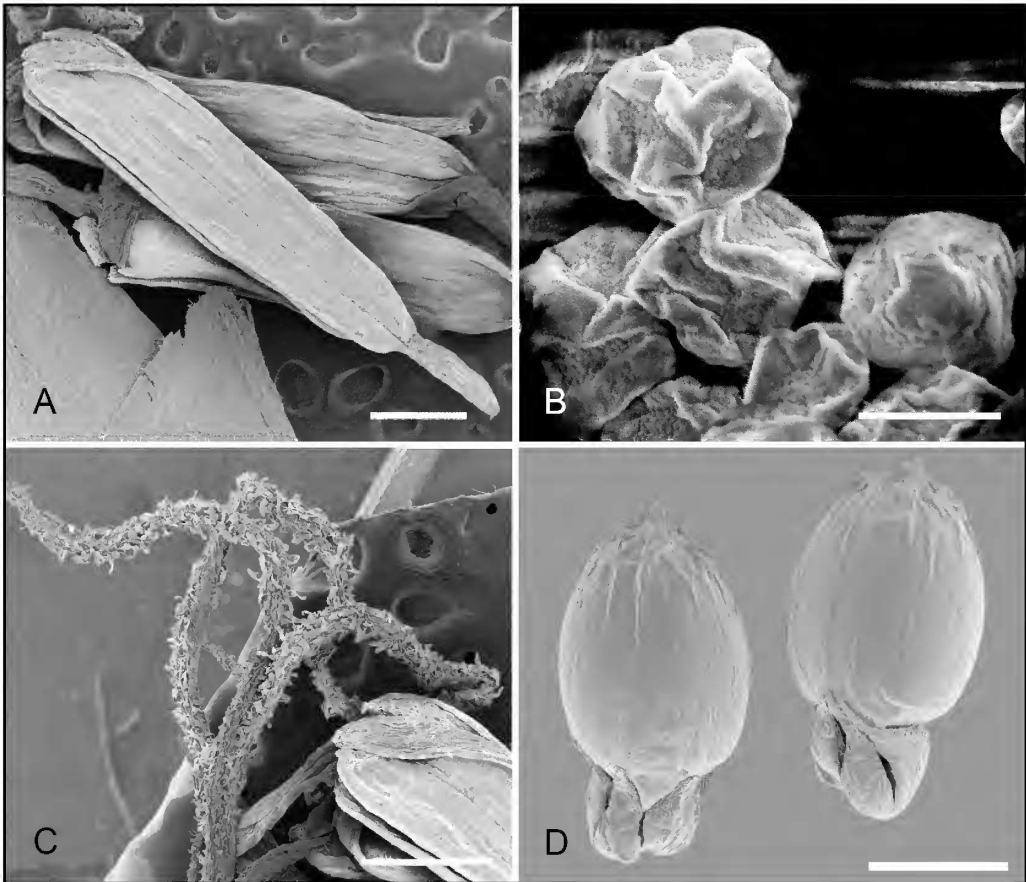


Figure 8. *Lepidosperma calcicola* (scanning electron micrographs). A – anther, showing appendage at right; B – pollen (possibly somewhat collapsed under vacuum); C – style and the three stigma branches; D – nuts with attached hypogynous scales (A, B – *R.L. Barrett* RLB 2660; C–F – *R. Davis* RD 844, PERTH). Scale bars. A = 500 μ m; B = 20 μ m; C = 500 μ m; D = 1 mm.

Selected specimen examined (c. 35 seen). WESTERNAUSTRALIA: below first lookout on Zamia Trail, 500 m SW of Reabold Hill, Bold Park, Floreat, 8 km W of Perth, 21 Oct. 2003, *R.L. Barrett* RLB 2658 (PERTH); *loc. cit.*, *R.L. Barrett* RLB 2659 (PERTH); *loc. cit.*, *R.L. Barrett* RLB 2660 (PERTH); on S side of old Skyline Drive-In, Bold Park, Floreat, 8 km W of Perth CBD, 21 Oct. 2003, *R.L. Barrett* RLB 2693 (PERTH); Grigson Lookout, West Coast Highway, N of Jurien Bay, 21 m alt., 14 Aug. 2012, *R.L. Barrett & P. Jobson* RLB 7788 (AD, NE, NSW, PERTH); Geographe Bay, Darling District, [pre 1898], *Miss Bunbury s.n.* (PERTH); 5 km S of Leeman, 9 Aug. 1995, *R.J. Cranfield* 9963 (PERTH); 1 km NE of Guilderton, 21 May 1996, *R. Davis* RD 844 (PERTH); Cockburn Sound, Rockingham, 8 Sep. 1907, *L. Diels* 2733 (B); NE of Wedge Island, 14 Nov. 1991, *E.A. Griffin* 6732 (PERTH); vacant block, 47 Karalundie Way, Mullaloo, c. 1 km inland, 29 Mar. 1986, *S.D. Hopper* 4799 (PERTH); Reserve 32259; Trigg townsite, 14 km N of Perth, 1 Dec. 1987, *G.J. Keighery* 9606 (PERTH); ‘In clivulis arenosis haud longe ab ora maritima (Perth)’, 9 June 1840, *L. Preiss* [*Plantae Preissianae* No. 1785] (BM, LD, P); District Swan: ‘in collibus calcareis prope mare’, Apr. 1901, *E.G. Pritzel* 267 (BM, DBN, G, NSW, P); Yanchep National Park, 15 m W from 210 m E along Cockatoo Walk Trail, 380 m NNW from intersection of Wanneroo Road and Old Yanchep Road, 24.5 km N of Wanneroo, GSS site 11B, 31 Oct. 2008, *D.A. Mickle & M.L. Swinburn* 414 (PERTH); 10 km SSE of Cape Freycinet,

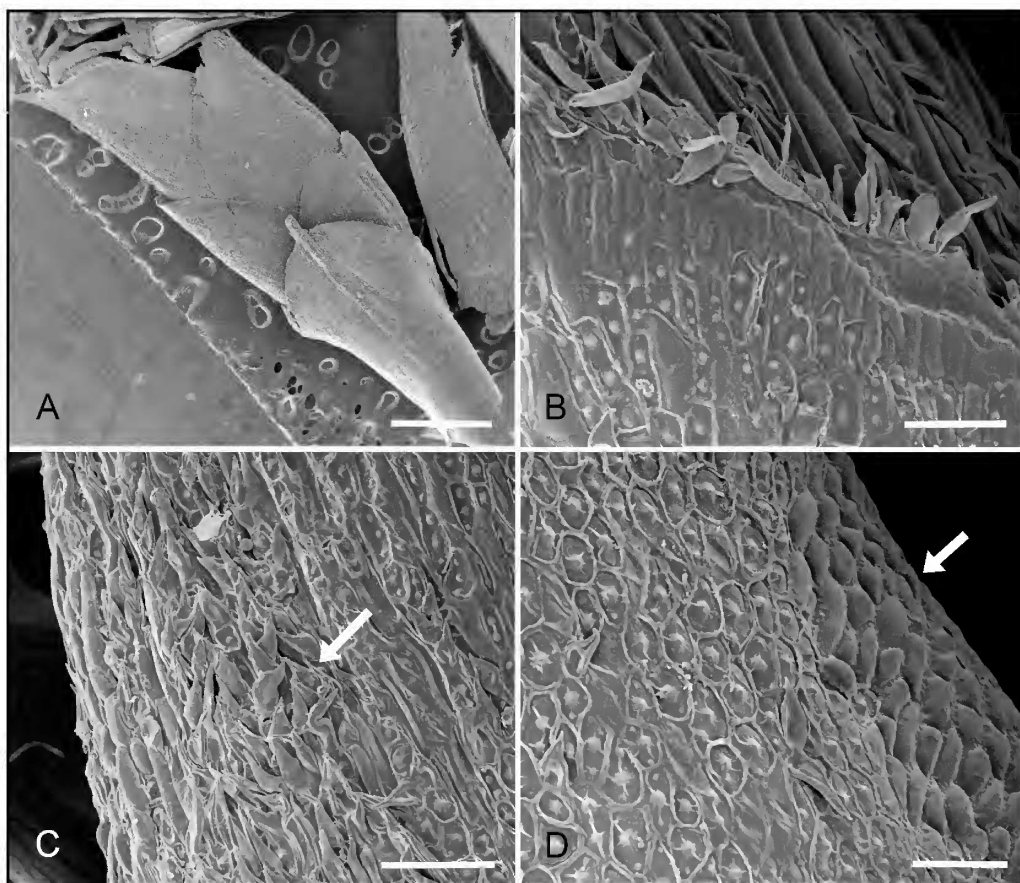


Figure 9. *Lepidosperma calcicola* (scanning electron micrographs). A – spikelet; B – fimbriate margin of spikelet; C – indumentum of fertile glume at keel (arrow indicating hairs); D – indumentum of fertile glume at margin (smooth cells indicated by arrow are the hyaline margin) (*R. Davis* RD 844, PERTH). Scale bars. A = 1 mm; B = 50 µm; C = 100 µm. D = 50 µm.

c. 20 km NNW of Augusta, 23 Jan. 1980, *K.R. Newbey* 6651 (NSW; PERTH); 21 km S of Dongara, 26 Oct. 1981, *K. Newbey* 9380 (PERTH); roadside, hilltop, 0.5 km E of lighthouse, Rottnest Island, 7 June 1999, *E. Rippey* 076 (PERTH); Rottnest [Island], 15 Nov. 1956, *R.D. Royce* 5666 (PERTH); Yancheep Beach, Aug. 1960, *G.G. Smith s.n.* (PERTH); N of Gnangara Road, W side of Lot 46 Maralla Road, locality of Ellenbrook, 28 Oct. 1999, *M.E. Trudgen* 20781 (PERTH); 7 km N of Leeman on Green Head road, 9 Nov. 1994, *K.L. Wilson* 8846 & *K. Frank* (NSW, K, MO, NE, PERTH); outskirts of Cervantes, on track to Lake Thetis, 10 Nov. 1994, *K.L. Wilson* 8866 & *K. Frank* (NSW, PERTH).

Phenology. Flowering recorded for May, coincident with the onset of winter rainfall.

Distribution and habitat. Relatively widespread on coastal dune systems of the Swan Coastal Plain and Geraldton Sandplains, from Bunbury north to Geraldton, on the west coast of Western Australia (Figure 5). A common species on exposed limestone outcrops in coastal heath, extending under open woodland in places on deeper sands. This species occupies a variety of calcareous substrates on stabilised sands and limestone ridges of the Quindalup, Spearwood and Bassendean dune systems. It is

commonly found growing in association with *Acacia lasiocarpa*, *A. saligna* subsp. *saligna*, *A. xanthina*, *Acanthocarpus preissii*, *Acrotriche cordata*, *Banksia attenuata*, *B. menziesii*, *Conostylis aculeata* subsp. *aculeata*, *C. candicans* subsp. *calcicola*, *Conostephium pendulum*, *Corymbia calophylla*, *Dasyogon bromeliifolius*, *Desmodcladus asper*, *D. flexuosus*, *Eremaea pauciflora*, *Eucalyptus gomphocephala*, *E. petrensis*, *E. rudis*, *E. todtiana*, *Hemiandra pungens*, *Hibbertia hypericoides*, *H. racemosa*, *H. spicata* subsp. *leptotheca*, *H. subvaginata*, *Kennedia prostrata*, *Kunzea glabrescens*, *Lepidosperma gladiatum*, *Lomandra maritima*, *Machaerina juncea*, *Macrozamia fraseri*, *Melaleuca preissiana*, *M. systema*, *Mesomelaena pseudostygia*, *Nuytsia floribunda*, *Opercularia vaginalis*, *Petrophile macrostachya*, *Phlebocarya ciliata*, *Scaevola anachusifolia*, *Spyridium globulosum*, *Stylidium maritimum*, *Templetonia retusa*, *Thomasia triphylla*, *Trymalium ledifolium*, *Xanthorrhoea brunonis* and *X. preissii*.

Conservation status. Widespread and not threatened.

Etymology. From the Latin *calci-* (lime) and *-cola* (dweller), in reference to the specific habitat of this species on coastal limestone and calcareous dunes.

Notes. As described here, this is a variable taxon, commonly forming short tussocks with very slender culms on exposed limestone, increasing in height and with broader culms when growing on deeper sands. No consistent differences have been identified and this variation is considered to be most likely ecotypic. It is possible that there are two genotypes involved, generally corresponding to the age of the dunes on which they occur, the shorter forms occurring on the younger Quindalup Dune System versus the taller form on the older Bassendean Dune System. The two forms can co-occur where these dune systems meet (e.g. in Bold Park, Perth: *R.L. Barrett* RLB 2658 and *R.L. Barrett* RLB 2660). The tall form was described by Rye (1987) under the name *L. sp. B* (excluding south coast specimens) while the small form was described as *L. sp. D*. Further investigation should be undertaken to determine whether there are ploidy differences between these forms.

Generally similar in appearance to *L. squamatum*, *L. calcicola* is distinctive in having compact ramet bases (rarely with vertical rhizomes) with long stoloniferous rhizomes. These vertical rhizomes do not appear to form even in the youngest dune systems that are more prone to sand burial. The rhizome bracts are closely appressed, with the apices breaking up, becoming fibrous. The biconvex culms are very finely grooved and the margins are smooth (several very distinct grooves in *L. squamatum*). The inflorescence is quite compact, with short lateral branches (inflorescence somewhat looser, more elongate in outline in *L. squamatum*). It differs from the related *L. scabrum* by the compressed (*vs.* sub-terete), non-scabrid (*vs.* scabrid) culms and reduced (*vs.* multi-branched and tangled) inflorescence.

This species is known to be a host plant for the graceful sun-moth (Barrett 2013).

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References

- Barrett, R.L. (2006). *Preliminary taxonomic studies of the sword sedges (Lepidosperma, Cyperaceae) in Western Australia*. Unpublished report. (Botanic Gardens and Parks Authority: West Perth.)
- Barrett, R.L. (2007). New species of *Lepidosperma* (Cyperaceae) associated with banded ironstone in southern Western Australia. *Nuytsia* 17: 37–60.
- Barrett, R.L. (2012a). Description of six species of *Lepidosperma* based on type specimens. *Nuytsia* 22: 295–322.
- Barrett, R.L. (2012b). *Systematic studies in Cyperaceae tribe Schoeneae: Lepidosperma and allied genera*. PhD Thesis. (School of Plant Biology, The University of Western Australia: Crawley.)
- Barrett, R.L. (2012c). *Poranthera moorokatta* (Phyllanthaceae), a rare new species from Perth, Western Australia. *Nuytsia* 22: 399–407.
- Barrett, R.L. (1991). Ecological importance of sedges: a survey of the Australasian Cyperaceae genus *Lepidosperma*. *Annals of Botany* 111: 499–529.
- Barrett, R.L. & Pin Tay, E. (2005). *Perth plants. A field guide to the bushland and coastal flora of Kings Park and Bold Park, Perth, Western Australia*. (Botanic Gardens and Parks Authority: West Perth.)
- Barrett, R.L. & Wilson, K.L. (2012). A review of the genus *Lepidosperma* (Cyperaceae: Schoeneae). *Australian Systematic Botany* 25: 225–294.
- Dixon, K.W. (2011). *Coastal plants. A guide to the identification and restoration of plants of the Perth region*. (CSIRO Publishing: Collingwood.)
- Kaila, L. (2011). *Elachistine moths of Australia (Lepidoptera: Gelechioidea: Elachistidae)*. *Monographs on Australian Lepidoptera Series 11*. (CSIRO Publishing: Collingwood.)
- Markey, A.S. (1997). *A floristic survey of the Northern Darling Scarp*. Unpublished report to the Western Australian Department of Conservation and Land Management, the Western Australian Department of Environmental Protection and the Western Australian Conservation Council (Inc.) for the Australian Heritage Commission. (Department of Conservation and Land Management: Perth.)
- Rye, B.L. (1987). Cyperaceae. In: Marchant, N.G., Wheeler, J.R., Rye, B.L., Bennett, E.M., Lander N.S. & Macfarlane, T.D. (eds) *Flora of the Perth region*. pp. 870–906. (Western Australian Herbarium: Perth.)
- Scott, J. & Negus, P. (2002). *Field guide to the wildflowers of Australia's south west: Augusta–Margaret River region*. (Cape to Cape Publishing: North Fremantle.)
- Western Australian Herbarium (1998–). *FloraBase—the Western Australian Flora*. Department of Environment and Conservation. <http://florabase.dec.wa.gov.au/> [accessed 17 January 2013].
- Wheeler, J.R. & Graham, L. (2002). Cyperaceae. In: Wheeler, J.R. (ed.) *Flora of the south west. Bunbury–Augusta–Denmark. Flora of Australia Supplementary Series 12*. pp. 263–298. (Australian Biological Resources Study, Canberra, Department of Conservation and Land Management, Como and University of Western Australia Press: Crawley.)